

STUDIES IN AUSTRALIAN NEUROPTERA.

NO. 8. REVISION OF THE FAMILY *ITHONIDÆ*, WITH DESCRIPTIONS
OF A NEW GENUS AND TWO NEW SPECIES.

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(With six Text-figures.)

In No. 4 of this Series of Studies (9), I dealt, among other families of the Planipennia, with the *Ithonidæ*, and described a new species, *Ithone fulva* Till., from Stradbroke Island, Queensland. Since that time, I have done a large amount of work on this interesting family, with the result that it is now possible to give a thorough revision of it, together with a complete account of the extraordinary life-history of the original species, *Ithone fusca* Newman, described as long ago as 1838 (6). In this paper, I propose to confine myself to the revision of the family, reserving the account of the life-history of *I. fusca* for a succeeding paper.

In 1853 (7), Newman first proposed the separation of *Ithone fusca* as the type of a new family *Ithonesidæ*, a name which I subsequently changed to *Ithonidæ* (9) in conformity with the rules governing zoological nomenclature. The classification adopted by Newman in this paper was very remarkable, considering the early date at which it was attempted, and was certainly worthy of greater attention than it has received from later entomologists. Briefly, he proposed to divide the old Linnean Order Neuroptera into two Orders: the Neuroptera, containing only those having no true pupal stage; and the Stegoptera, containing those with a true pupal stage. Thus he was the first to recognise the seriousness of the error by which both hemimetabolous and holometabolous insects had been placed within the confines of a single Order; an error that is by now universally admitted by all thinking entomologists. In his Order Stegoptera he included

the Caddis-flies, Alder-flies, Snake-flies, and Lacewings; in other words, his single Order comprised the insects which we now distribute between the three Orders Trichoptera, Megaloptera, and Planipennia. His Order was divided into four groups, Phryganeina, Myrmeleonina, Hemerobiina, and Corydalina. The latter was again divided into four families, according to the following key (7, p. cci.) :—

Ocelli 3 :—

Body clothed with hair *Ithonidæ* Newm.

Body naked :—

Antennæ simple..... *Corydalidæ* Newm.

Antennæ pectinated..... *Chauliodesidæ* Newm.

Ocelli 0 *Sialidæ* Leach.

Thus it will be seen that the *Ithonidæ* were associated with the Megaloptera, instead of with the Planipennia, though it is now generally agreed that they belong to the latter Order.

Inadequate as we now know Newman's classification to have been, yet there is no denying the fact that the *Ithonidæ* are, amongst all Planipennia, the most closely related to the Megaloptera. In my previous paper, I gave reasons why it appeared very likely that the larva of *Ithone* might be aquatic (9, p. 281). If such had proved to be the case, and if, as might further have been expected, the larval type of the *Ithonidæ* had shown close affinity with that of the Megaloptera, and its pupa had proved to lie free in the earth, without forming any cocoon, then the separation of the two Orders Megaloptera and Planipennia could no longer have been maintained. There are, indeed, many present-day entomologists who refuse to recognise these two Orders, on the ground that the imagines cannot be separated by any characters of sufficient importance. Such authors, of whom we may take Comstock (4) as an example, treat these two groups as Suborders within a single Order Neuroptera. Their position is quite logical. The Planipennia, however, are so distinct from all other Neuropteroid insects in possessing their unique suctorial larva, in which the mandibles and maxillæ are developed together to form a pair of sucking-jaws, that it is, from the point of view of the Phylogenetist, unwise to merge them with any other group: and

I propose to continue to treat them as a separate Order for the present. This point of view, I may now say, has been justified by the discovery that the larva of *Ithone* does actually possess the typical suctorial jaws of the Planipennia, although its pupa lies free in the earth, without a cocoon.

If, then, we are agreed that the *Ithonidae* are an archaic group of insects, deserving of family rank within the Order Planipennia, we have next to enquire into the composition of that family. Comstock (1, p.177) has recently suggested the inclusion in it provisionally of the remarkable Oriental genus *Rapisma*. I agree with Comstock that "the limits and distinguishing characteristics of the *Ithonidae* must be determined by a study of other characters as well as those presented by the wings"; but, until this can be done for *Rapisma* as well as for *Ithone*, I cannot accept the inclusion of that genus within the family. Hence I propose to omit it from consideration in this paper, and to confine my attention to the purely Australian insects belonging to the genus *Ithone* and its close allies.

We are now faced with an initial difficulty as to the identity of Newman's original type of *Ithone fusca*. In 1853(7), Newman wrote:—"The *Ithonidae* appear to be a numerous group, confined to New Holland. *Ithone* is the only genus described, but there are many species, and these very dissimilar, and likely to be generically subdivided when we become better acquainted with the entomological productions of the wonderful country in which they are found." Thus he must have known of the existence of other species besides his *I. fusca* at this date, though he did not describe any, and did not attempt to indicate more fully the distinguishing characteristics of the single species he had described. The next species described was *Varnia perloides* Walker, from Western Australia, in 1860. The types of this insect and of *I. fusca* are both in the British Museum. The only other *Ithonidae* so far described are *Nespra impleva* Navás, from Central Australia, in 1914, and *Ithone fulva* Tillyard, from Queensland, in 1916. The type of the former is in the British Museum, that of the latter in my collection.

Thus, at the present time, the family *Ithonidæ* contains four described species, allotted to three genera. Most fortunately for future studies, the types of three of these species are located in the British Museum.

When I wrote my previous paper on this family(9), my collection contained only the two males of *I. fulva* from Stradbroke Island, together with two specimens of a much larger and darker species, taken at light at Hornsby, N.S.W. One of these latter insects had been sent to Mr. P. Esben Petersen, the well-known Neuropterist, of Silkeborg, Denmark, and had been determined by him as belonging to *I. fusca* Newman. It was on this determination that I figured the male appendages of this species (9, Pl. xii., figs.7-9) for comparison with those of *I. fulva*.

From 1916 onwards, I was most anxious to discover the larva of *Ithone*. For this purpose, I showed my insects to Mr. Luke Gallard, to whom the family was at that time unknown, and told him of my experiences with them on Stradbroke Island. He became very interested in them, and promised to keep a sharp look-out for further specimens. In October, 1917, while he and his family were staying in a cottage near the Ocean Beach, Woy Woy, Mrs. Gallard discovered, about 6 o'clock one evening, a specimen of *Ithone* sitting on a post. This led to further finds, and Mr. Gallard returned at the end of a week with about two dozen specimens, most of which had been found hiding in an old outhouse near the cottage. Last year I spent a week with Mr. Gallard in the same cottage, at the beginning of November, with the result that we not only obtained about two hundred of the imagines, but also discovered the larva and pupa, and obtained many hundreds of fertile eggs. The full account of these interesting discoveries will be given in a later paper.

Now the extraordinary thing was that this abundant species, which agreed well enough with Newman's description of *I. fusca*, was most certainly not the same species as the one I already had in my collection, and which Petersen had already determined as the true *I. fusca*. It was not even congeneric with it; for the Woy Woy species has constantly only a single radial sector in

the forewing, whereas the Hornsby species, like *I. fulva*, has either two or three separate radial sectors in the forewing. The appendages of the males are also quite different, those of the Woy Woy species being of normal size and of simple forcipate shape like those of *I. fulva*, whereas those of the Hornsby species are immense claspers of a very specialised broad shape. Referring to Newman's description of *I. fusca*, in order to solve this problem, I was disappointed to find that he makes mention neither of the condition of Rs in the forewing, nor of the form of the appendages, although his type specimen was a male.

Thus it was impossible, on the evidence at hand, to determine whether the Woy Woy or the Hornsby species was the true *I. fusca* of Newman. There was only one method of solving the problem, viz., to have specimens of both insects compared with Newman's type in the British Museum. With this purpose, I wrote to my friend Mr. Herbert Campion, and sent him one of my Hornsby specimens, together with a series of the Woy Woy insects, and a specimen of a very distinct paler species from Tasmania and Victoria. His reply to my request has now reached me, and definitely clears up all doubts, not only about the identity of *I. fusca*, but also about the other species represented in the British Museum. For this help, without which a revision of this family could not possibly have been attempted, I now desire to offer him my most cordial thanks. He writes as follows :—

“ I think there can be no doubt that two remarkably similar, but nevertheless distinct, species have been going under the name of *Ithone fusca*. Newman's species is represented in your collection by the specimens from Woy Woy, while the other (which, so far as I am aware, stands without a name) is represented by the insect from Hornsby. I distinguish the two insects thus:—

Larger species; 2 Rs in forewing; anal appendages of ♂ expanded dorso-ventrally, excavated at apex	Gen. et sp. incert.
Smaller species; 1 Rs in forewing; anal appendages of ♂ not expanded dorso-ventrally, pointed at apex	<i>Ithone fusca</i> Newm.

“In addition to Newman’s type, the B.M. has two other males of *Ithone fusca*, while a female of the large species is registered thus, under the year 1845:—‘Australia (Harrington); purch. of Argent.’

“As to your *Ithone pallida* (this was the MS. name under which I sent the Tasmanian species to Mr. Champion—R.J.T.), I do not see how it can have very much to do either with *Varnia perloides* or with *Nespra impleva*. For one thing, the wings are unspotted, instead of being marked with blotches along the veins. For another thing, the costal veinlets in the forewing are for the most part simple and regular; whereas in *V. perloides* they are either forked anteriorly or anastomosed and irregular. In *N. impleva* the costal space is filled with an intricate meshwork of little veins, recalling the condition prevailing in the elytra of Acridiid Orthoptera.

“I do not know how Navás distinguishes *Nespra* from *Varnia*, as he compares his genus with *Ithone* alone. There is a good deal of resemblance between the two types, although there is a great disparity in size, and *V. perloides* is more heavily spotted, especially on the hindwings. But of course I am comparing a single male with a single female, and I do not know enough of the group to say how far sexual differences extend, neither can I tell what, if any, colour-changes take place during life. . . . I cannot understand why Walker’s genus *Varnia* should have been allowed to lapse, and its contents transferred to *Ithone*, for it seems to me that species having two Rs in the forewing must be generically distinct from forms possessing only one Rs.”

Thanks, then, to Mr. Champion’s careful comparison of the species in the British Museum with those in my own collection, it is now possible to make the following assertions:—

(1) The species determined by Petersen from my own collection, and by Navás in the British Museum Collection, as being *Ithone fusca* Newm., is not that species, but a species that so far has no distinctive name.

(2) The true *Ithone fusca* Newm., is the same species that is so common at Woy Woy, and possesses only one Rs in forewings.

(3) *Ithone fulva* Tillyard, possessing either two or three Rs in forewings, is not congeneric with *Ithone fusca* Newm., and must form the type of a new genus.

(4) The unnamed species mentioned in (1), in that it also possesses two or three Rs in forewing, should be placed in the same genus as *I. fulva* Till.

(5) The Tasmanian and Victorian species, *I. pallida* Till. MS., which also has a variable number of Rs, two or more, in the forewings, should also go into this genus. It will be described in this paper under its MS. specific name.

(6) Walker's genus *Varnia* is a valid one, and should not have been suppressed by McLachlan.

(7) Navás' genus *Nespra* is not sufficiently distinct from *Varnia* Walker; and it is quite possible, seeing that the females in this family are normally much larger and darker than the males, that his *N. implexa* is only the male of *V. perloides*. This is the more likely, when one recalls the fact that the sand-dwelling insects of Western Australia mostly extend unchanged right into Central Australia, many of them reaching to the limit of the dry belt in Western Queensland.

It remains to be added that Comstock (t, p.175, fig.170) has correctly figured the wings of *Ithone fusca* Newm., with a single Rs in forewing, and has correctly inferred that my *I. fulva* is not congeneric with it. But he is quite in error in stating that, in the hindwings of *I. fulva*, "veins Sc and R coalesce throughout the distal half of their length." This statement clearly shows that he studied my figure without troubling to read my paper, in which (9, p.280) I clearly stated that "in Plate xii, fig. 1, the radius and subcosta appear to be fused, but actually R stands on a high ridge, with Sc sunk far beneath it, so that the two come into line when viewed from above." This fact, of course, made it inevitable that the two should *appear* fused in the figure.

We may now proceed to redefine the characters of the family, in the light of our latest knowledge, and to give keys and descriptions of the genera and species.

Family ITHONIDÆ.

Large, stout-bodied lacewings of superficially moth like appearance, the females larger than the males.

Head:—*Antennae* filiform, tapering, the basal joint stout, the rest formed of from 40-50 short cylindrical joints, increasing in length gradually from base to tip; length from two fifths to three-fifths of that of forewing; bases fairly close together. *Ocelli* absent, or at the most vestigial.* *Eyes* button-like, prominent, occupying almost the whole of the two sides of the very short but rather wide head. *Mandibles* well developed; without internal teeth. *Maxillary palpi* five-jointed; *labial palpi* three-jointed (Text-fig.6).

Thorax (Text-fig.5):—*Prothorax* strongly built, with the head sessile upon it; much wider than long. *Meso-* and *metathorax* both well developed, quite separate; their coxæ apparently in two separate pieces (the true coxa, and an attached piece from the epimerum). *Legs* moderately stout and long, the tibiæ with a pair of strong apical spurs, the tarsi five-jointed, the most basal joint being the longest, the next three decreasing in length, the last joint longer again; tarsal claws and a bilobed empodium well developed. Large *spiracles* present between prothorax and mesothorax, and also between meso- and metathorax (Text-fig. 5, *sp*₂, *sp*₃).

Wings:—Forewings of tougher consistency than hind, somewhat leathery. Both pairs of wings fairly wide, held roof-like over the body when at rest. Costa of forewing slightly arched near base, so that the costal space is slightly widened; a humeral recurrent vein present; costal veinlets numerous, sometimes branched or connected by cross-veinlets. Sc and R₁ close together, connected only by a single cross-vein near base, and by one or more towards apex. Apparent radial sectors one or more, with a moderate number of pectinate branches; frequently the original dichotomic branching of R₄₊₅ is retained. R₁ markedly bent concavely to the costa in the pterostigmatic region, with a number of closely-set branches. M two-branched, connected

* Newman says "Ocelli 3," but this is surely an error!

basally with R in forewing. Cu with its strong anterior branch (Cu_1) carrying pectinate posterior branches only distally; the weaker Cu_2 dichotomously branched. The three anal veins distinct, all branched. Cross-veins weakly formed, only moderately numerous, scattered irregularly about on the disc. Main veins and their branches hairy; cross-veins without hairs. Jugal lobe and humeral process present, but no definite frenulum.

Abdomen stout, cylindrical, shorter than the wings; formed of eight complete segments, with reduced ninth and tenth also present, the latter in the form of a small *proctiger* carrying the anus. Eight pairs of spiracles, on segs. 1-8 respectively; the first pair very large, the others small (Text-fig.5, *asp*₁, *asp*₂). *Anal appendages of male* consisting of a pair of large superior appendages of forcipate shape, and a single, broad, valve-like, inferior appendage or *hypandrium*; between these lies the penis, with its projecting penis-hooks or *pennae*. In the female, the abdomen ends in a peculiar *psammotrum* or sand-plough, from which depend two tactile appendages; the *anus* lies dorsally above and anterior to this organ, apparently upon seg. 8, but actually on the reduced tenth segment. The genital opening lies in a slit at the posterior end of the sand-plough, which is part of seg. 9.

Eggs large, oval, soft, deposited in the sand, which adheres to them, owing to a sticky secretion with which they are covered.

Larva a soft, whitish, burrowing, blind, melolonthoid grub, with small mandibles and maxillæ fashioned for sucking.

Pupa a *pupa libera*, not enclosed in a cocoon; lying free in the sand. (See postscript, p.437).

Distribution: Confined to Australia and Tasmania, so far as known. Inhabitants of sandy places, including the central desert region, as well as the coast-line.

(A full account of the life history will be given in a later paper of this Series).

The *Ithonidæ* differ so much from all other Planipennia, that I have no hesitation in proposing to separate them from the rest as a new Suborder ITHONOIDEA, distinguished by their remarkable larva, the pupa free in the earth, without a cocoon, and the

imago stout-bodied and moth-like in appearance, with large mandibles and generalised Prohemerobiid type of wing-venation.

Key to the Genera of *Ithonidae*.

- (1) { Forewing with only a single radial sector..... ITHONE, Newm.
 { Forewing with two or more apparent radial sectors 2.
- (2) { Wings unicolorous; the costal veinlets of the forewing with little or no tendency to branching, and with few or no cross-veinlets connecting them. Eastern Australia only HETERITHONE, n.g.
 { (Type. *Ithone fusca* Till.).
 { Wings with the veins marked with black or fuscous; the costal veinlets of the forewing frequently branched, and frequently connected together by cross-veinlets. Western and Central Australia only VARNIA Walk.

Genus ITHONE Newm. (Text-figs. 1a, b, 2, 3, 5, 6).

Newman, Ent. Mag., 1838, v., p.181; Zool., 1853, xi., Appendix, Art. xxix., p. cci.

Characters as for the family, with the addition that the fore wing has only a single radial sector.

Genotype, *Ithone fusca* Newm.

Habitat: Sandy places along the coast-line of New South Wales.

The genus, as now restricted, contains only the type-species, which appears to be abundant enough, if looked for at the right season and in the right places.

ITHONE FUSCA Newm. (Text-figs. 1a, b, 2, 3, 5, 6).

Newman, Ent. Mag., 1838, v., p.181.

As Newman's description is far too general, and does not distinguish the species definitely from its near neighbours, it is redescribed here, with special attention to the anal appendages, which are of great value in the determination of the various species.

♂. Total length (dried), 16-20 mm.; abdomen (dried), 10-14 mm.; forewing, 19-24 mm.; hindwing, 17-22 mm.; expanse, 40-52 mm.

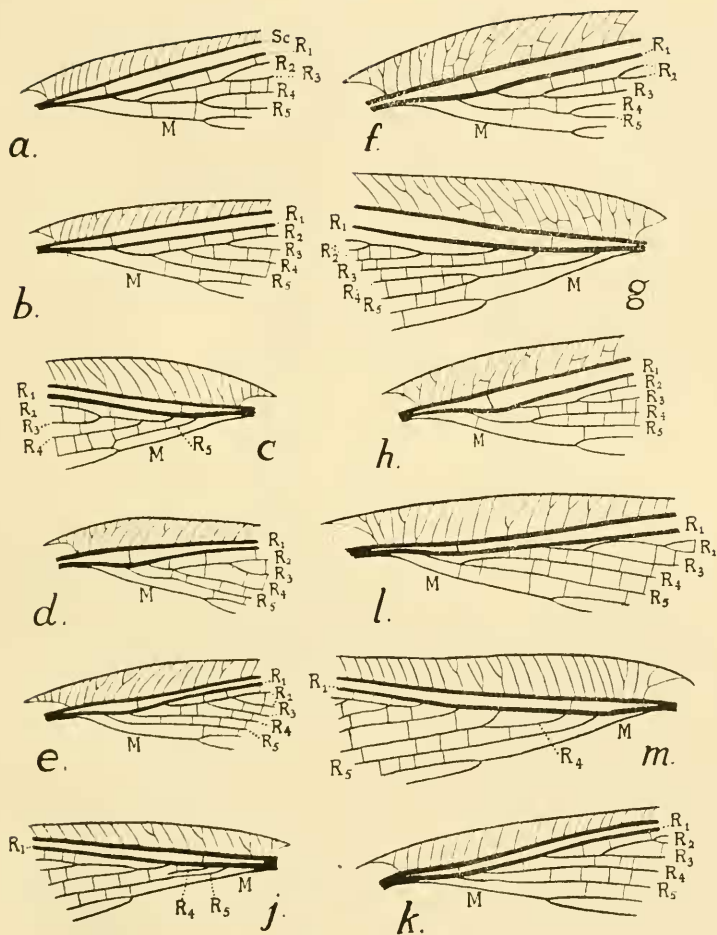
Head blackish-brown above, the *eyes* grey-black; *antennae* dark brown, with two conspicuous creamy areas at their bases, forming a kind of inverted V-mark between them on the frons; below this a conspicuous, black, transverse band from eye to eye; *clypeus* and *mouth-parts* a medium brown.

Thorax hairy above, brownish, paler on sides; legs brown.

Wings:—Forewings fuscous, semi-transparent; hindwings somewhat paler. Costal space of forewing not very much broadened; its veinlets set close together, and very few of them branched; humeral recurrent vein short, usually with only a single anterior branch to it. The single radial sector of the forewing may be either completely pectinately branched, or R_{4+5} may retain its original dichotomic branching; these two formations are figured in Text-fig. 1, *a* and *b*. An analysis of nearly two hundred specimens of both sexes shows that about 40 per cent. of the specimens have the dichotomic branching of R_{4+5} in both forewings, only 20 per cent. the complete pectinate branching in both, and about 40 per cent. have one forewing with one condition and the other with the other condition. Thus 60 per cent. of the total number of forewings have the dichotomic condition present, and only 40 per cent. the pectinate. The total number of branches descending from Rs before the region of the pterostigma varies from three to six.

Abdomen fuscous above, brown beneath; segs. 1-2 hairy; seg. 1 paler above. Each segment has a pair of oblique pale marks dorsally, placed well apart on either side of the middle line, and laterally a pale curved band.

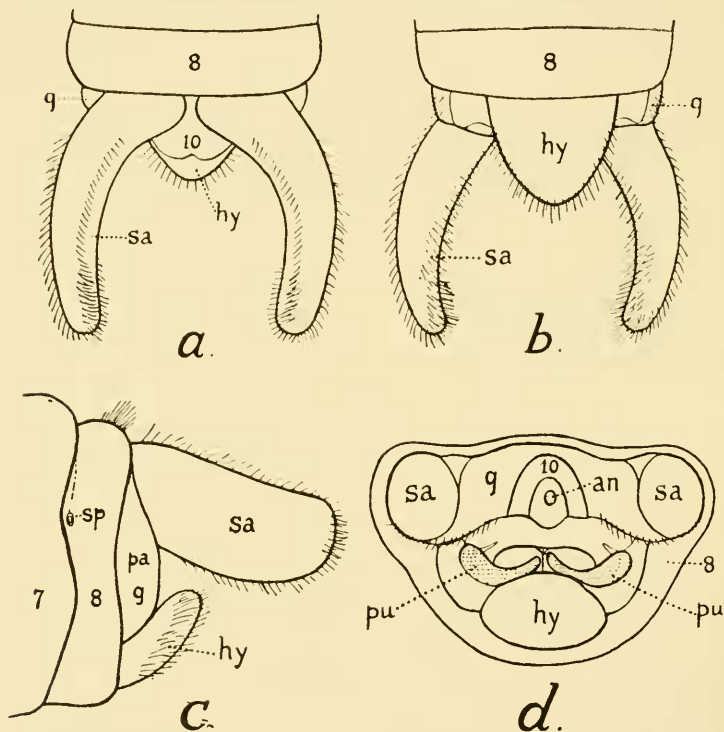
Appendages pale brownish; the *superior* in the form of a pair of strong forceps about 2.4 mm. long, of moderate width viewed dorsally or ventrally, but much wider when viewed laterally (see Text-fig. 2, *sa*); the *inferior* a single, broad, valve-like hypandrium (Text-fig. 2, *hy*) lying beneath the penis, whose hard, brown, chitinous hooks or penunci (Text-fig. 2, *d, pu*) can be seen above its base. The anus lies on the reduced tenth segment or *proctiger*, midway between the two superior appendages (Text-fig. 2, *d, an*) (See also Crampton, 3, fig. 14).



Text-fig. 1.

Structure of the costal space and radial sectors in the forewings of various *Ithonide* (all $\times 6$). *a*, *Ithone fusca* Newm., δ , to show the dichotomic branching of the single Rs. *b*, the same, with Rs pectinately branched. *c-d*, *Heterithone fulva* (Till.), δ paratype, left and right forewings. *e*, *H. fulva* (Till.), δ holotype, right forewing. *f-g*, *H. megacerca*, n.sp., δ holotype, right and left forewings. *h*, *H. megacerca*, n.sp., δ paratype, right forewing. *j-k*, *H. pallida*, n.sp., δ holotype, left and right forewings. *l-m*, *H. pallida*, n.sp., δ allo- type, right and left forewings. (Compare Text-fig. 4c).

♂. Total length, 20-26 mm.; abdomen, 13-18 mm.; forewing, 25-28 mm.; hindwing, 22-24 mm.; expanse, 52-60 mm.

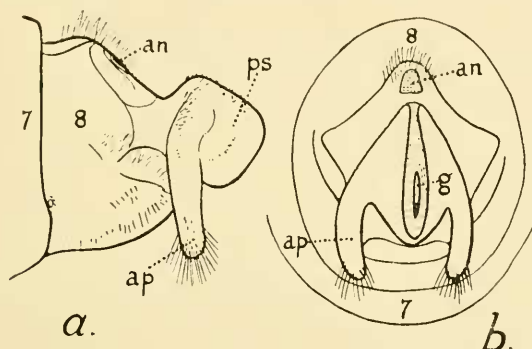


Text-fig. 2.

Ithone fusca Newm., ♂. Abdominal appendages. *a*, dorsal view; *b*, ventral view; *c*, lateral view; *d*, posterior view; *an*, annus; *hy*, hypandrium or inferior appendage; *pa*, paraproct; *pu*, penunci or penis-hooks; *sa*, superior appendages or surgonopods; *sp*, spiracle; 8, 9, 10, abdominal segments. ($\times 12$). (Compare Text-fig. 4, *a*, *b*).

Generally similar in appearance and colouration to ♂, but with somewhat darker and broader wings, and darker abdomen. There may be as many as seven descending branches from Rs, and the humeral recurrent vein of the forewing may have two or three anterior branches. The end of the abdomen is peculiarly modi-

fied, with a view to the laying of the eggs in the loose sand. The eighth, ninth, and tenth segments are more or less fused together, forming the projecting end of the abdomen; of these, the ninth segment is terminal, the reduced tenth being situated more dorsally upon the eighth, and carrying the anus, as in Text-fig.3, *an*. The ninth segment is flattened from side to side



Text-fig.3.

Ithone fusca Newm., ♂. End of abdomen. *a*, Lateral view; *b*, posterior view; *an*, anus; *ap*, tactile appendage or gonopod; *g*, gonopore or genital opening; *ps*, psammatrotrum or sand-plough; 7, 8, abdominal segments. ($\times 12$).

to form the unique *psammatrotrum* or sand-plough, with which the insect ploughs the loose sand while ovipositing. From the base of this segment, on either side, there projects downwards an unjointed appendage, ending in a rounded tip with numerous hairs; these, though very like cerci in appearance, must be true gonapophyses or gonopods, from their position; they clearly act as feelers during oviposition, and must be homologous with the more elongated but otherwise similar organs in the females of *Berothidae*.

Types: Holotype of ♂ in British Museum Coll., from New Holland; presented by the Entomological Club; described by Newman in 1838(6). Allotype ♀ in Coll. Tillyard; this sex not having been previously described, I have selected a fine speci-

men, with the largest measurements given in the above description, as allotype; loc. Woy Woy, N.S.W., Nov. 6th, 1918.

Besides these, there are two other males in the British Museum Collection, one in the Collection at Cornell Univ. (venation figured by Comstock, 1, fig.170), a number in Mr. Luke Gallard's collection, and thirty males and six females in my own collection, all from Woy Woy. I have also a large number in alcohol, and have distributed set males to many correspondents.

Habitat: Sandy places along the coast of New South Wales. Woy Woy, abundant during first half of November in the bush near the Ocean Beach. Jervis Bay, abundant at same date around the Naval College.* The males, which are much more abundant than the females, assemble around the latter at dusk, on tree-trunks or fence-posts, running actively about like Cockroaches, or flying wildly round like Hepialid Moths. In the air, both sexes appear of a very pale, almost whitish colour.

Genus **HETERITHONE**, n.g. (Text-fig.1, c-m).

Differs from *Ithone* only in the possession of two or more apparent radial sectors in the forewing.

Genotype, *Ithone fulva* Till.

Habitat: Sandy places in Eastern Australia.

This genus contains three species, which may be separated by the following key:—

- | | | |
|-----|---|--|
| (1) | {
Dark, fuscous species of large size, with the appendages of
the male of enormous size, pointed apically, and almost as
broad as long when viewed laterally <i>H. megacerca</i> , n.sp. | |
| | | {
Paler species, with males of smaller size, and their append-
ages of normal forepate type..... 2. |
| (2) | {
Abdomen dull fulvous; the wings with a tinge of mauve.
Stradbroke Island, Queensland <i>H. fulva</i> (Till.). | |
| | | {
Abdomen pale ochreous, the wings very pale, not tinged
with mauve. Victoria and Tasmania <i>H. pallida</i> , n.sp. |

HETERITHONE FULVA (Till.). (Text-fig.1, c-e).

Ithone fulva Till., These Proceedings, 1916, xli., Part 2, p.279, Pl. xii., figs.1-6.

* I have to thank my friend Lt. Commdr. Paymaster L. H. Mosse-Robinson for this observation.

To the description and figures given, it is only necessary to add that, although the type male has *three* apparent radial sectors on each forewing, the second male in my collection shows only *two*; while, in the left forewing, one of these (R_5) becomes attached to M near the forking of the latter.

Type: Holotype ♂, Coll. Tillyard; Stradbroke Island, Q. A second male in my collection, from the same locality.

♀ unknown.

Habitat: Apparently confined to Stradbroke Island, Q.

HETERITHONE PALIDA, n.sp. (Text-fig.1, *j-m*).

♂. *Total length*, 23 mm.; *abdomen*, 11 mm.; *forewing*, 21 mm.; *hindwing*, 18 mm.; *expause*, 47 mm.

Very close to *H. fulva* (Till.), from which it differs in the following points:—General colour pale ochreous, with a black line behind the eyes in the suture between head and prothorax. Wings very transparent, almost colourless, the veins very pale; no tinge of mauve on them at all. Antennæ with the basal joints pale yellowish-brown, the rest gradually darkening to dark brown towards tip (those of *H. fulva* are of a uniform rich orange-brown). Appendages rather short, of normal forcipate type, but somewhat broader than those of *H. fulva* when viewed laterally.

♀. *Total length*, 25 mm.; *abdomen*, 18 mm.; *forewing*, 30 mm.; *hindwing*, 27 mm.; *expause*, 66 mm.

Closely resembles the male, but much larger and stouter. No dark band between head and prothorax. Wings very broad, with 7-8 descending branches from R_s , instead of 5-6, as in the male. *Sand-plough* strongly cultriform in shape, the angle being placed dorsally; the two gonopods very short and inconspicuous.

Types: Holotype ♂ in Coll. Tillyard; Point Lonsdale, Victoria, taken at light by Mr. J. A. Kershaw. Allotype ♀ in Coll. Tillyard, loc. Victoria, received in exchange from Mr. G. F. Hill.

A second male in my collection, also received from Mr. Kershaw, is somewhat smaller than the type, the expause being 44 mm.

Habitat: Sandy places in Victoria and Tasmania. I have

in my collection also two males, closely resembling the type, from Ulverstone, Tas., taken by Mr. A. M. Lea, and received in exchange from Mr. G. H. Hardy.

This species may have anything from two to four apparent radial sectors in forewing. The type male has only two in each forewing. Text-fig. 1, *j-k*, show the interesting conditions of the radial sectors in the two forewings of the second male from Victoria; while Text-fig. 1, *l-m*, show the even more striking conditions in the allotype female.

HETERITHONE MEGACERCA, n.sp. (Text-fig. 1, *f-h*).

Ithone fusca Till. (*nec* Newm.), These Proceedings, 1916, xli., Part 2, p. 279, Pl. xii., figs. 7-9.

♂. Total length, 25 mm.; abdomen, 17 mm.; forewing, 25 mm.; hindwing, 22.5 mm.; expanse, 53 mm.

This very striking species has a close general resemblance to *Ithone fusca* Newm., with which it has hitherto been confounded. The principal differences are as follows:—

The general build is more robust, the abdomen stouter and longer, apparently without any definite pattern, the antennæ shorter and somewhat stouter, the wings very distinctly wider and more broadly rounded at the tips. In the forewings, besides the presence of more than one apparent radial sector, the costal margin is thickened and darkened, and both R_1 and Cu_1 are very strong, darkened veins, much more prominently convex than in *I. fusca*. Also the costal space is much wider, and its veinlets tend to fork considerably, while a few of them are actually connected by cross-veinlets, as in the genus *Varnia* (*see* Text-fig. 1, *f-h*). The appendages of the male, which are of great size and extraordinary shape, have been already described and figured by me as belonging to *I. fusca*, and it is only here necessary to refer to those figures (9, Pl. xii., figs. 7-9).

The male of *H. megacerca* has the size and build of a female of *I. fusca*. The female is unknown to me, but should be correspondingly larger and more heavily built than the male. Mr. Champion (*antea*, p. 419) states that there is a female of this species in the British Museum Collection; but, at the time he

wrote this, I am not sure that he knew of the great difference in size between the two sexes in this family. It is, therefore, possible that this specimen is really a large female of *I. fusca*. I should estimate that the expanse of the average female of *H. megacerca* would be about 70 mm., while the difference in the shape of the wings, especially the greater breadth towards the apex of the forewing, ought to be even more strongly marked than in the male.

Type: Holotype ♂ in Coll. Tillyard, taken at light at Hornsby, N.S.W., in November, 1913. A second male, slightly smaller than the type (length, 24 mm.; expanse, 52.5 mm.) is also in my collection; it was taken at light at Hornsby in Nov., 1909.

Genus *VARNIA* Walker. (Text-fig.4).

Walker, Trans. Ent. Soc. London, 1860, v., p.197. (Suppressed by McLachlan, 1870, Ent. Mo. Mag., 1869-70, p.26:—"Genus *Varnia* Walker = *Ithone* Newman. *V. perloides* is an interesting second species of this curious genus." No reason at all is offered for the suppression). *Nespra* Navás, Rev. Real Acad., Madrid, 1914, p.478.

Characters as given in the key on p.423.

Genotype, *Varnia perloides* Walker (Western Australia).

Habitat: Sandy places in Western and Central Australia.

The only specimens known of this genus, apparently, are the type ♀ of *V. perloides* Walker, from Western Australia, and the type of *Nespra impleta* Navás, from Central Australia, both in the British Museum Collection. I have not seen these insects, but it is quite clear, from Mr. Champion's study of them, that they must be regarded as congeneric, seeing that they agree in the three important characters of having the veins of the wings marked with fuscous or black, the possession of more than one apparent radial sector in the forewing, and the costal veinlets in that wing much forked and connected together by means of cross-veinlets. The only difference is that of size, which we now know to be a characteristic difference between the sexes in this family. I therefore have no hesitation, firstly in restoring the

genus *Varnia* Walker, with its type *V. perloides*, and secondly in suppressing the genus *Nespra* Navás, as a synonym of *Varnia* Walker. It should be noted that Navás only compared his new genus with *Ithone* Newman, thus showing that he was either ignorant of the existence of Walker's genus, or, at any rate, not cognisant with its characters, which were those of his new genus itself.

VARNIA PERLOIDES Walker.

Walker, Trans. Ent. Soc. London, 1860, v., p.197.

The length of body in this insect is 21 mm., the expanse of wing 55 mm. (Walker gives the measurements in lines).

Type: Holotype ♀ in British Museum Collection.

Habitat: Western Australia.

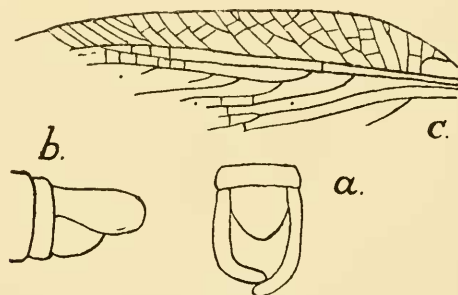
VARNIA IMPLEXA (Navás). (Text-fig.4).

Nespra implexa Navás, Rev. Real Acad., Madrid, 1914, p.478.

Length of body, 15 mm.; forewing, 19 mm., implying an expanse of wing of about 43 mm.

Type: Holotype ♂ in British Museum Collection.

Habitat: Central Australia (Hermannsburg, H. J. Hillier, 1911).



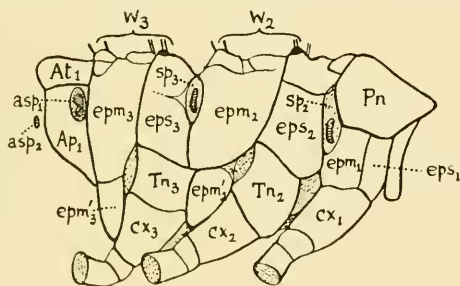
Text-fig.4.

Varnia implexa (Navás), male. *a*, dorsal and *b*, lateral view of appendages; *c*, costal space and radial sectors of forewings, for comparison with Text-figs.1-2. (After Navás).

The measurements and description show that this insect may perhaps be the male of *V. perloides* Walker. I have copied

herewith the figures given by Navás of the venation and appendages, for comparison with those of other genera and species of the families figured in this paper (Text-fig.4). It is to be hoped that the discovery of further specimens of both sexes of either this species or *V. perloides* may soon settle the question of whether one or two species are represented by the two known specimens.

In suggesting the vernacular name "Moth-Lacewings" for the insects of this family, I do so with a desire to emphasise not only their superficial resemblance, in structure and habits, to certain archaic moths, such as, for instance, the smaller and duller *Hepialidae*, but also because, being one of the very oldest existing types of Planipennia, they do show actually a closer morphological approach to the Lepidoptera than do most other



Text-fig. 5,

Ithone fusca Newm. Thorax of male, lateral view, ($\times 6$). Ap_1 , plenum of first abdominal segment; asp , abdominal spiracle; At_1 , tergum of first abdominal segment; cx , coxa; epm , epimerum; eps , episternum; Pn , pronotum; sp , thoracic spiracle; Tn , trochantin; w , attachments of wing. The suffixes 1-3 indicate the parts belonging to pro-, meso-, and meta-thorax respectively.

insects of their Order. Quite apart from the moth-like form of the head and body, the greatly reduced labium with its long three-jointed palpi, and the very typically Hepialid-like position of rest and manner of flight, we can see, by a study of the thoracic exoskeleton, how very close this ancient type really comes to the Lepidoptera. Text-fig. 5 shows the thorax of

Ithone fusca, viewed from the side. It will be seen that the structure of the coxæ of the middle and hind legs is the same as in the older Lepidoptera, a special piece of the epimerum (*epm'*) being separated off from the principal part of the sclerite, and attached posteriorly to the coxa in question. The position and shape of the two large thoracic spiracles also resemble those of the older Lepidoptera. The prothorax is more primitive than in any known Lepidoptera, the pronotum being well developed, and the pleurum definitely divided into two parts.

Snodgrass(8) and Crampton and Hasey(2) have shown that the character of the specialised coxæ is common to the Mecoptera, Trichoptera, Megaloptera, Planipennia, and Lepidoptera; but *Ithone* appears to show this more clearly than other Lacewings, possibly because of its greater robustness.

The *Ithonide* might also very appropriately be named the "Cockroach-Lacewings," since they exhibit certain superficial resemblances to Cockroaches. Their quick powers of running, the peculiar texture and "feel" of their wings and bodies, their fondness for running over one in the field, and their aptitude at hiding away in dark places, are all characters that suggest a resemblance to these insects. Moreover, as I hope to show later, their internal morphology shows that they are more closely related to the Cockroaches than these superficial resemblances would suggest.

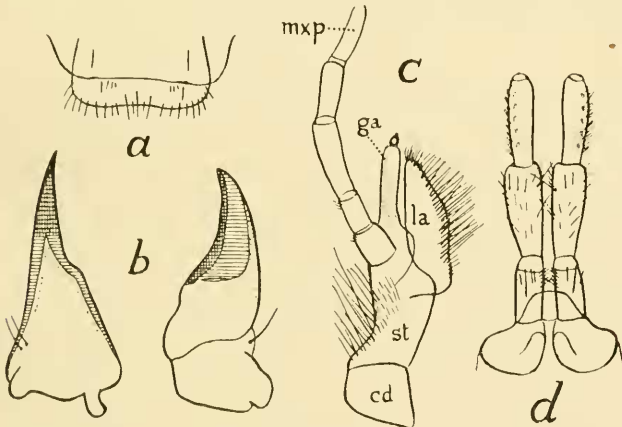
In conclusion, I should like to remark that the very specialised life-history of this family proves it to be a very early side-branch of the Planipennia, lying well off the main line of descent of present-day groups from the original Prohemerobiid types of the Trias and Lias. As this life-history is by now almost completely worked out, I shall hope to give a full account of it in a future paper.

Note on the mouth-parts of the Ithonide. (Text-fig.6).

Text fig.6 shows the mouth-parts of the male of *Ithone fusca* Newm., for comparison with those of other archaic Planipennia, such as *Psychopsis* (10, p.812, Text-fig.12).

The *labrum* (Text-fig.6*a*) is closely similar to that of *Psychopsis*, but there is a delicate lobe attached to it on the inner side, which appears to represent the epipharynx. As the figures for *Psychopsis* were not made from fresh specimens, it is possible that the epipharynx may have been shrivelled in these, and was thus overlooked.

The *mandibles* (Text-fig.6*b*) are of the primitive Panorpid type, elongated, pointed, and without internal teeth. Those of the male are longer and sharper than those of the female. They differ from those of *Psychopsis* in not possessing any inner broad lobe. The difference may be correlated with the absence of a cocoon in the pupal stage of the *Ithonidae*; if so, then the form of mandible found in the imagines of *Psychopside* is partially



Text-fig.6.

Ithone fusca Newm. Mouth-parts of male. *a*, labrum and epipharynx; *b*, left and right mandibles; *c*, left maxilla, with *cd*, cardo, *ga*, galea, *la*, lacinia, *mcp*, maxillary palpus, and *st*, stipes; *d*, labium. (All $\times 30$).

due to specialisation in the pupal stage, in which, as I have previously shown (10, p.808, Text-fig.10) the mandibles are more strongly formed than in the imago, and are used for cutting open the cocoon. Of what use the mandibles are to the *Ithonidae* I do not know, as these insects appear to live only a few days; I

should doubt whether they take any food at all that requires the use of mandibles, and I have never found anything except air inside the alimentary canal of a number of specimens that I dissected. It is possible that they are only of use to the males for fighting one another when assembling around a female for pairing; but I have not observed any actual combats; only a disposition to drive one another away.

The *maxillae* (Text-fig.6,c) closely resemble those of the *Psychopsidae*, having the primitive five-jointed palpus, a well developed *galea* with a small terminal knob, which may be the vestige of a distal joint, and a somewhat flat, blade-like *lacinia*, more pointed than in *Psychopsis*, and with its outer margin carrying numerous closely-set stiff hairs. The *stipes* is elongated, as in *Psychopsis*, but much narrower, and carries a large number of stiff hairs, some of them of considerable length, on its outer margin. The *cardo* is short, as in the *Psychopsidae*.

The *labium* (Text-fig.6,d) differs from that of *Psychopsis* in showing considerable reduction of all parts except the *palpi*, which are well developed, three-jointed, and set close together at their bases, as in the Lepidoptera. The first or basal joint is short, the second longer and wider, the third slightly shorter than the second, and much narrower; this joint carries a row of five sensory pits or depressions, with sets of minute hairs close to them, and its tip is bluntly rounded and transparent, probably carrying another sense-organ. There are larger hairs on the first and second joints, of which a set of five stiff ones, close together, projects from the inner side of the basal joint, while one or two large, stiff bristles cross one another on the inner sides of the second joints. The *mentum*, *submentum*, and inner lobe of the *labium* are much reduced, and there does not appear to be any definite hypopharynx as in the *Psychopsidae*.

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Postscript, added 10th September, 1919: Since the above was written, both Mr. Gallard and myself have discovered, almost simultaneously, the cocoon of *Ithone*. Thus the discovery of the pupa and pupal skin free in the earth, last year, led to an erroneous conclusion, and is only to be explained on the supposition that the pupa was found while on its way up through the sand. All statements in the present paper about the pupa lying free in the earth should be deleted. The cocoon and pupa will be fully described in a future paper.—R. J. Tillyard.